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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/614,407	07/12/2000	Bo Zheng	AMAT/4471/CALB/COPPER/SB	1903

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APPLIED MATERIALS, INC.
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EXAMINER	
SMITH HICKS, ERICA D	

ART UNIT	PAPER NUMBER
1741	

DATE MAILED: 01/13/2003 18

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/614,407	Applicant(s) ZHENG ET AL.	
	Examiner Erica Smith-Hicks	Art Unit 1741	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *15 October 2002* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *32-97* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *32-84* is/are allowed.

6)☒ Claim(s) *85-92 and 96* is/are rejected.

7)☒ Claim(s) *93-95, 97* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *16* .
4) ☒ Interview Summary (PTO-413) Paper No(s). *17* .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after allowance or after an Office action under *Ex Parte Quayle*, 25 USPQ 74, 453 O.G. 213 (Comm'r Pat. 1935). Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, prosecution in this application has been reopened pursuant to 37 CFR 1.114. Applicant's submission filed on October 22, 2002 has been entered.

Information Disclosure Statement

2. The information disclosure statement (IDS) submitted on October 22, 2002 is in compliance with the provisions of 37 CFR 1.97 and has been considered by the Examiner.

Claim Rejections - 35 USC § 112

3. Claims 86, 87, 89, 90 and 96 are rejected under 35 U.S.C. 112, first paragraph, because the specification, while being enabling for "ramping current" over time, does not reasonably provide enablement for "ramping voltage". The specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to perform the process of the invention commensurate in scope with these claims. On page 13, lines 22 of the instant Specification, Applicants' disclose that the bias voltage is constant during a first application of voltage. This appears to directly conflict with the instant claim limitations. Please clarify.

Claim Rej ctions - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

6. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

7. Claims 85-92 are rejected under 35 U.S.C. 103(a) as being unpatentable over TAYLOR et al. US 6,203,684 B1 in further in view of TSAI et al. US 6,224,737 B1.

TAYLOR et al. (hereafter TAYLOR) teach a method for depositing metal on a plating surface of an object immersed in an electrolyte solution prior to bulk deposition on the horizontal surface of the plating surface, the method comprising applying a voltage form an anode to the plating surface to enhance the concentration of metal ions in the electrolyte solution that is contained in a feature on the plating surface at col. 2, lines 18-35 of the reference. TAYLOR further disclose the method further comprising applying a current from the anode to the plating surface to deposit metal from the metal ions in the feature, the current is applied prior to the bulk deposition at col. 3, lines 50-63.

While TAYLOR et al. disclose a sufficiently applied current time and voltage, they fail to expressly teach a biasing voltage and current times of less than 5 seconds.

TSAI et al. provide these teachings in claim 8 of the reference wherein a biasing voltage of 2.2 is applied for up to 5 seconds, thus disclosing the limitations of claims 85, 92.

TAYLOR and TSAI et al. in combination teach all of the limitations of Applicants' instant rejected claims and are combinable as they are from the same technology area of biasing voltage for seamless fill of semiconductor micro-features.

It would have been obvious to a person of skill in the art at the time of the invention to have employed processing times and voltage as taught by TSAI et al. in the TAYLOR method because TSAI et al. have shown where these processing parameters

would have sufficiently created biasing effect for tailoring the seamless fill of semiconductor features, thus enhancing the overall plating uniformity.

Moreover, the limitations of claim 86-90, the specific voltage and application times would have been considered a result effective variable by one having ordinary skill in the art. As such, one having ordinary skill would have routinely optimized the voltage and the processing times of the biasing and plating methods to obtain the desired plating benefits attendant therewith given the combined teachings of TAYLOR and TSAI et al. In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980). In re Aller, 105 USPQ 233. As indicated above, TSAI et al., disclose a voltage in the range of zero to about 1-5 volts, for a period of 0.125 seconds to 1 second. The primary reference to TAYLOR provides a general teaching of voltage and time application that is sufficient to attract ions to proximate the plating surface at col. 3, lines 50-54 and wherein the current is applied for a sufficient duration to fill the feature at col. 11, lines 28-30.

Allowable Subject Matter

8. Claims 93-97 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

9. Claims 32-84 are allowed.

10. The following is an examiner's statement of reasons for allowance: Applicants' arguments of Paper No. 9, (Interview Summary) have been fully considered and found persuasive. Further, Applicants newly amended claims, drawing said claims commensurate with the scope of Applicants' arguments, better set forth the patentable distinction of the claims over the prior art of record, and now place the claims in condition for allowance.

While updating the search, the Examiner disclosed two closely related prior art patents to Applicants' invention: SIMPSON et al. US 6,174,425 B1 and FORSTER et al. US 6,334,419 B1.

SIMPSON et al., disclose a process for depositing a layer of material over a substrate wherein the method comprises placing the substrate in a plating system including a first electrode (anode), a second electrode electrically connected to the substrate and biasing the first electrode (anode) to a first potential and the second electrode (cathode substrate) to a second potential to deposit the layer of material, wherein the first and second potentials are different (column 6, line 65 through col. 7, line). The process taught by SIMPSON et al. further comprises applying the biasing current by generating a pulsing current (col. 7, lines 15-17). While SIMPSON et al. teach a method wherein first and second biasing currents are used, the instant claims do not read over the prior art as the first and second biasing voltage as well as the pulsing voltage are applied to the seed layer of the substrate in the instant invention, as opposed to the prior art's application of biasing voltage to different electrodes (anode and cathode substrate) of the system.

The FORSTER et al. method as shown in Figure 15 and 16 employs a similar varied voltage deposition onto a substrate surface. The FORSTER et al. method applies biasing voltage to the substrate to control deposition and avoid excessive deposition on the sidewalls of device features by modulating bias to the target (col. 11, lines 5-64). However, FORSTER et al. differs from the instant invention as it involves sputter deposition and does not provide for electrochemical deposition. Moreover, the waveform and biasing pattern employed by FORSTER et al. differs significantly from the instant embodiment.

Upon a reasonable search of the prior art, the Examiner was unable to find a teaching of Applicants' express method (nor apparatus for performing the method) for depositing metal on a substrate wherein the method comprises applying first and second biasing voltages whereby the second biasing voltage is higher than the first biasing voltage and further application of a pulsed biasing voltage applied to the seed layer during electrodeposition. Applicant's novel method and apparatus offers an improvement over the prior art as it allows for seamless trench-filling of damascene structures on semiconductor substrates and further more uniform deposition of conductive material thin-film layers thereon with minimal need for subsequent planarization. The novel method and apparatus of the instant invention cuts down on processing steps and therefore overall manufacturing cost associated with subsequent removal processes.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Erica Smith-Hicks whose telephone number is 703/ 305-7645. The examiner can normally be reached on Tue-Fri., from 8:00 a.m.-6:30 p.m.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on 703/ 308-3322. The fax phone numbers for the organization where this application or proceeding is assigned are 703/ 872-9310 for regular communications and 703/ 872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703/ 308-0661.

NAM NGUYEN
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 1700

Erica Smith-Hicks
Examiner
Art Unit 1741

ESH
January 7, 2003